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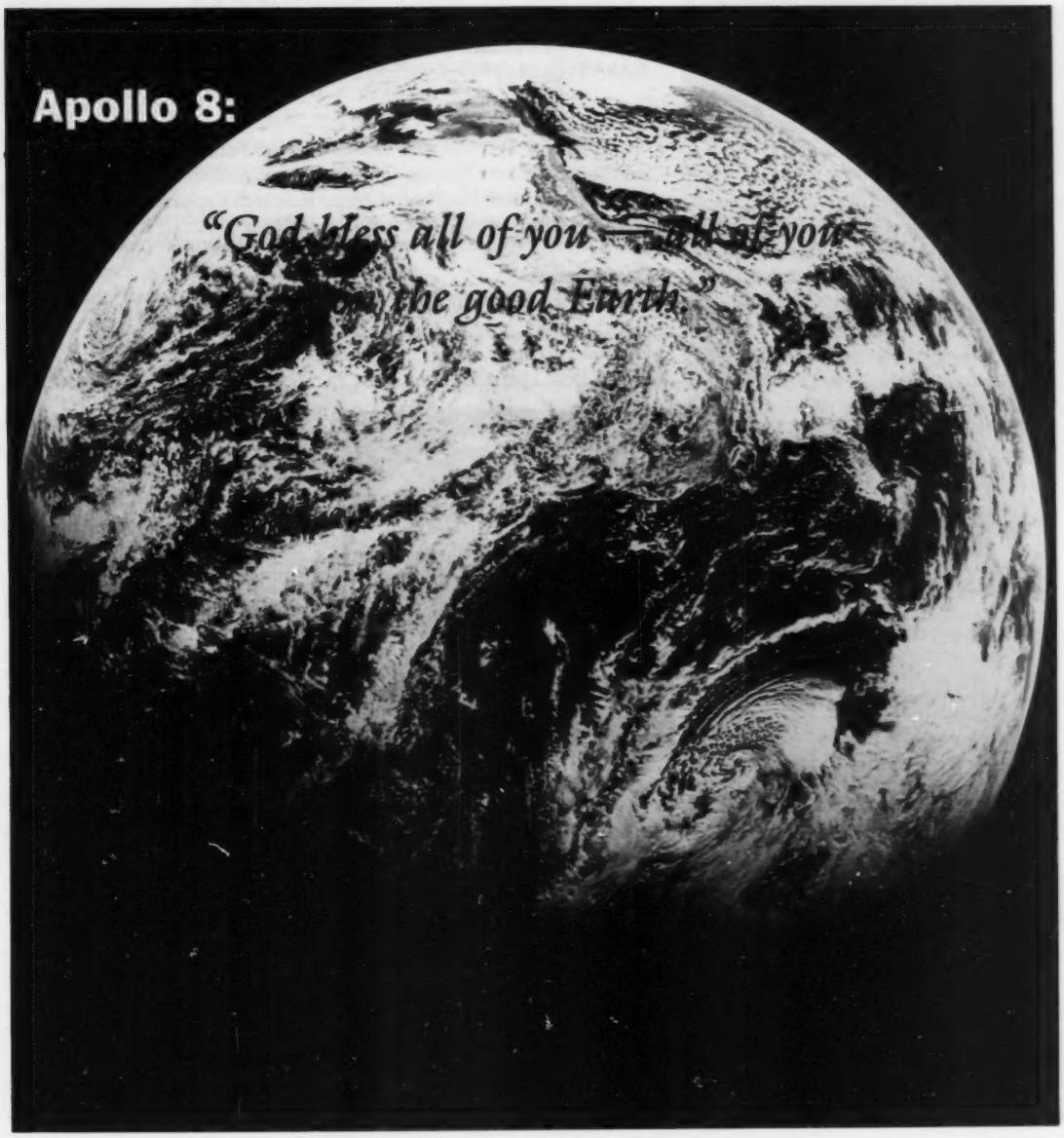

THIS ISSUE

This month marks the twentieth anniversary of humanity's breaking the bonds of gravity to travel to another celestial body.

During this holiday season, it may be timely and appropriate to remember what a courageous and meaningful mission Apollo 8 was. Against the cold blackness of space, mankind was extending the light of his curiosity and understanding—yet still with a sense of humility that recognized the vast infinity, and the "goodness" of creation. It was more than a technical triumph and it gives us a renewed sense of perspective. This month's cover and "NASA Visions" records some of the scenes from our first mission to the Moon.

A sense of perspective is also provided by this issues's "Official Comment" column. Excerpts from an address by Dr. Fletcher to the National Press Club help us understand where NASA is and where it is going.

The shape of things to come, or how to design and build future space structures and control them, might describe the aim of a new technology program. This "Agency Highlight" story tells of a new effort for study of Controls-Structures Interaction which offers the potential of greatly improved spacecraft designs.

The STS-27 mission is recognized in this issue. A classified, Department of Defense dedicated flight, STS-27 nonetheless points out the important contribution of the Space Transportation System to the Nation's defense. We salute its crew!

Space technology brought down to earth is the result of NASA technological and scientific efforts. A JPL program called "Firefly" will help forest fire fighters manage fires with realtime infrared data. The program is described in "Center Highlights."

Next Month:

A Look at Shuttle C. Using existing systems may cut costs and improve access to space.

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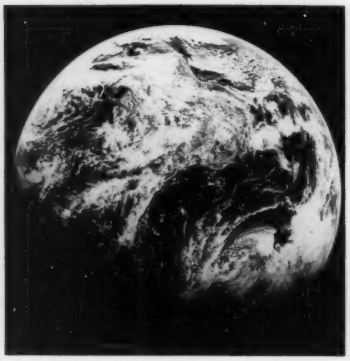

About the Cover

Apollo 8, December, 1968. A striking view of Earth from the Apollo 8 spacecraft, showing nearly the entire Western Hemisphere from the mouth of the St. Lawrence River, including nearby Newfoundland, to Tierra del Fuego at the southern tip of South America. Never before had mankind viewed his natal planet from such a distant location as translunar space.

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NASA's Return to Flight and Beyond

by NASA Administrator James C. Fletcher

Excerpts from remarks to the National Press Club, October 18, 1988.

With the recent mission of Discovery, America's civil space program is back on track. America is back in space, and back to stay.

When that wise old sage, Yogi Berra, was asked what makes a great manager, he replied: "A great team." America is back in space because of the efforts of a great team—the NASA team.

That team made it happen. They were careful. They were cautious. They were dedicated. And they'll continue to be all that and more because they're building America's future in space—and doing it safely.

My second Yogi quote concerns, in part, the point I want to make here today: "When you come to a fork in the road," said Yogi, "take it."

Since that leaves the destination in doubt, let me be more specific.

We have come to a fork in the road in America's civil space program. And the path we choose will determine whether the country moves on to a new plateau of exploration, discovery and enterprise; or whether it lags behind, as other nations forge ahead.

All the pieces are in place to build the nation's future in space. The Shuttle is flying again, and soon will be complemented by a fleet of expendable launch vehicles.

A private American space launch industry that didn't even exist two years ago is well underway.

With our international partners, we're beginning to develop Space Station Freedom, which will give the Free World a permanent presence in space by the mid-1990's.

We have President Reagan's National Space Policy, which states that America's long-term goal is to expand the human presence into the solar system, and directs NASA to develop the advanced Pathfinder technologies that will allow us to realize that goal.

> "Our minds and our imaginations have been stretched by space exploration... and we can never be purely Earthbound again."

So, it's clear that we have entered a new era.

Still, two big questions are continually asked. The first is: What should be this nation's goal or goals beyond the space station? The second is: Can the nation afford to support a strong and growing civil space program that includes the long-term goal of human expansion into space?

President Reagan answered the first question very well in welcoming home Discovery's crew. He said: "Ours is the first generation in human history that has had the tools to bring mankind into the heavens, into space; and America intends to stay there.... Today, vistas beyond imagination are being opened for humanity in space; a new future of freedom, both peaceful and bountiful, is being created, and America is telling the world, follow us, we'll lead you there."

NASA is vigorously pursuing the necessary technology and options that will allow the next Administration to move the country into high gear to move forward into that new future.

Only the American people can answer the second question: Can the nation afford a vital and vigorous civil space program? The answer will depend on whether they are willing to accept second place in world leadership for lack of an annual investment of only one percent of the Federal budget?

What the American people decide to do and when we decide to do it not only will shape NASA's future; but also will determine if the United States will lead the ranks of space-faring nations well into the 21st century. It is vital to choose the right path, and stick to it for decades if we're to remain a leader in science and technology in the next century.

That's why I believe that the next President must set the nation solidly on course for the future. He must do this by challenging the United States to achieve a specific, long-term goal in space, by setting a timetable, and by directing NASA to get on with it.

Recent public opinion polls suggest that over the past two years Americans decided they want more, not less spending on space.

Those polls and others I've seen confirm what I've always believed: Americans put space very high on their list of national priorities, now and for the future. Americans are more aware than ever that space exploration is essential to their

national well being and to America's future.

What are the possibilities of moving beyond the space station and into the solar system?

Well, with the Shuttle, which will be moving the people and materials into low Earth orbit, we expect to complete Space Station Freedom by the mid-1990s. And in that respect, I was gratified that President-elect Bush recently announced his intention, as President, to commit the nation to develop an operational space station by 1996.

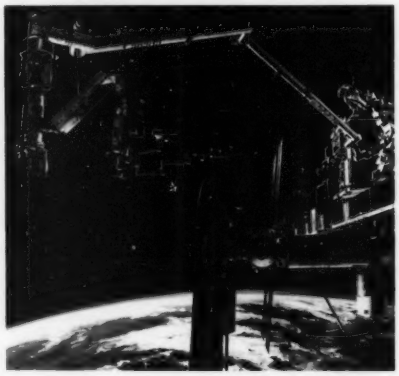
The space station is the essential infrastructure for human expansion into space. It is the key to human capability to live and work in space longer than we do now—much longer. Without it, I can assure you, this nation will not have the place to test the technologies and systems needed for people to live in space for periods of long duration. And without it, we will have no place to assemble and fuel major manned missions beyond Earth orbit.

In recent years, NASA's long-range planning efforts were given new impetus by two reports.

The first report, called "Pioneering the Space Frontier," was published by a Presidentially-appointed commission—the National Commission on Space. In its report, the commission recommended that the country adopt an aggressive plan for its next 50 years in space. That plan would lead to the first human outposts on the Moon by 2005 and on Mars by 2013.

The second report is entitled "Leadership and America's Future in Space," and was published last year. It grew out of my request to Dr. Sally Ride to head a task force to look at potential future goals of the civil space program. Dr. Ride's report identified and reviewed four options that could serve as the basis for future U.S. leadership. The first is Mission to Planet Earth, which NASA has already begun to pursue. The other three goals are intensive Robotic Exploration of the Solar System; an Outpost on the Moon; and Human Exploration of Mars.

The report also recommended that NASA establish an Office of Exploration to examine options and alternatives for human exploration of the solar system.



I established NASA's Office of Exploration last year and soon they will issue their first annual report. Let me preview that report briefly for you now.

Drawing on previous studies and expertise from throughout the agency, four potential manned missions have been defined.

The first is a four-person expedition to one of the Martian moons—Phobos or Deimos—landing in 2003. This case study includes a modified version of such a mission using a two-person crew.

The second is an expedition to Mars, landing by 2007. The third case study is establishment of a scientific base on the Moon, landing by 2004. And the fourth is establishing a lunar outpost by 2004, which could serve as a staging area for a Martian landing by 2014.

By the early 1990's or before, a feasible, logical and achievable goal will be presented to the NASA Administrator for recommendation to the President.

But if the next President were to ask me the day after election day to name the most promising of the options NASA is exploring, I'd name the fourth option: a manned lunar outpost.

At this point a manned lunar outpost looks most desirable for many reasons.

Clearly, we would learn to live on a world very different from our own. We could test the machinery for "closed loop" ecological systems that would be essential for future planetary voyages. A permanent scientific observatory on the Moon would be an indispensable tool for studying the solar system, the galaxies and the universe. And the resources of the Moon, the lunar rocks, could be mined to make liquid oxygen, and perhaps, liquid hydrogen, for propellants to fuel future spaceships to Mars. Finally, the experience and inheritance of equipment, laboratories and habitats of a manned lunar outpost could be transferred, if we so chose, to Mars' missions. Thus, they would go a long way to help reduce the risks and costs of building a Mars outpost.

Space is an essential part of our country's future. Public support is strong today for America's adventure in space. And I trust it will continue.

The philosopher Mortimer Adler wrote: "A mind once stretched can never return to its former dimensions." Our minds—and our imaginations—have been stretched by space exploration and its boundless potential for human betterment. And because that's so, the human race can never be purely Earthbound again. ■

AGENCY HIGHLIGHTS

New Technology Program for Spacecraft Design

Controls-Structures Interaction Focus for Future Designs

A team of experts from government, industry and academia has been assembled to tackle a dilemma that traditionally has plagued the engineering disciplines of controls and structures. The dilemma—finding the proper tradeoff between a spacecraft's control requirements and its weight, size and structural flexibility—is a perennial aerospace problem. NASA believes the answer can be found in controls-structures interaction (CSI) technology, which offers potential for greatly improved spacecraft designs of the future.

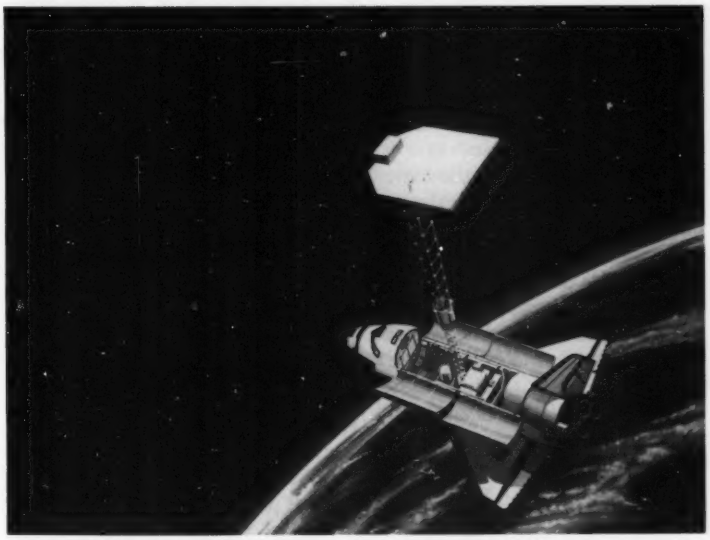
The CSI program will be directed from NASA Headquarters, Washington, D.C., and combines the talents and resources of the Langley Research Center, Hampton, Va.; the Marshall Space Flight Center, Huntsville, Ala.; and the Jet Propulsion Laboratory, Pasadena, Calif. Specialists in structures and controls will work side by side to advance an interdisciplinary technology for spacecraft of the year 2000 and beyond.

In conjunction with the establishment of the CSI initiative, NASA has selected eight companies and universities for negotiations leading to award of contracts and/or grants for the first phase of the CSI guest investigator program. This phase one program is a two-year effort at a total funding level of $2 million.

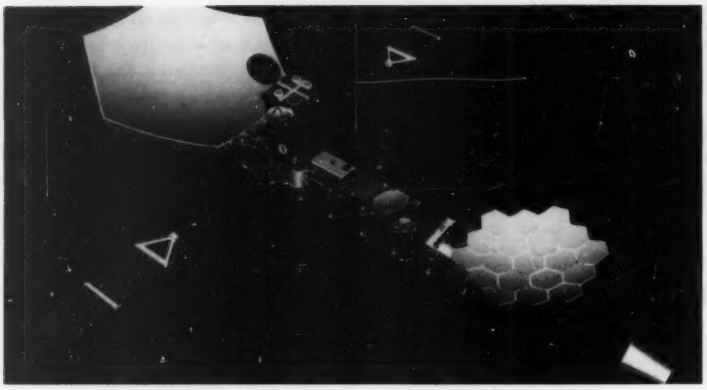
Selected from a field of 62 submittals were proposals from:

- Boeing Aerospace Company, Seattle, Wash.; Dr. J. Michael Chapman, principal investigator (PI)
- DEI-Tech, Inc., Newport News, Va.; Wilmer H. Reed III, PI
- Harris Aerospace Systems Division, Melbourne, Fla.; Dr. David C. Hyland, PI
- California Institute of Technology, Pasadena, Calif.; Dr. John C. Doyle, PI
- Massachusetts Institute of Technology, Cambridge, Mass.; Dr. Wallace E. Vander Velda, PI
- Purdue University, W. Lafayette, Ind.; Dr. Robert E. Skelton, PI
- University of Cincinnati, Ohio; Dr. Randall Allemang, PI
- University of Texas, Austin; Dr. Bong Wie, PI

Guest investigator programs provide a mechanism for strong interaction of ideas and techniques between university, industry and government researchers, often resulting in significant technology advances. The immediate focus for the CSI guest investigator program is on ground-based testbed activities with future in-space flight experiment opportunities to be defined in subsequent phases. The next announcement of opportunity for the CSI guest investigator program is planned for Spring 1989.



Controls and Structures Experiment in Space (CASES) is a possible CSI flight experiment that would test our ability to stabilize a very flexible structure in the Shuttle bay while being accurately pointed at a fixed point in space. The structural configuration represents a scientific concept for a pinhole occulting X-Ray telescope.



Ground-based CSI testbeds will be used to develop analytical and test methods on structures representative of a geostationary platform that might be used for communications and Earth observations.

The CSI initiative is an outgrowth of the control of flexible structures element of NASA's Civil Space Technology Initiative program. The prime objective of the CSI program is to develop and validate the technology needed to design, verify and operate spacecraft in which the structure and the control system complement each other to meet the requirements of 21st century space missions. Emphasis is on increased analysis and ground testing, with a conservative flight experiment schedule to verify the anaylsis and ground test data.

CSI-focused mission categories include large optical systems, large space antennas and special missions, such as an evolutionary space station and remote manipulator systems. These types of missions need very large, distributed-mass components, greater surface and pointing precision, increased use of moving components, as well as increased use of multi-mission platforms with multiple control systems on board.

Methods will be developed which allow the controls and structures analysis and design functions to use unified mathematical models. Verification of methods in hardware applications and tests is emphasized and will require development of hardware concepts and test methods for implementation.

Because of the close interrelationships among the many elements—structure, control hardware and software, analysis and design approach—a highly interdisciplinary activity is planned. Structures, dynamics, control, computer and electronics engineers are co-located and working together on a daily basis.

Daniel R. Mulville of the Materials and Structures Division, Office of Aeronautics and Space Technology, NASA Headquarters, is the overall CSI program manager. Langley Research Center has the lead role for technical program coordination. Jerry R. Newsom, formerly assigned as technical assistant to NASA Administrator James C. Fletcher, has returned to Langley to manage the CSI office. Henry B. Waites leads the effort at Marshall Space Flight Center, which is responsible for in-space flight experiments. William E. Layman heads the CSI program at the Jet Propulsion Laboratory, where the focus is on microprecision technology. ■

NASA Commercial Center Awards Launch Services Contract

NASA and the Consortium for Materials Development in Space (CMDS) have awarded a $1 million commercial launch services contract to Space Services Inc., Houston. CMDS is a NASA-sponsored Center for Commercial Development of Space (CCDS) at the University of Alabama-Huntsville.

Under the contract, funded through a NASA grant to the commercial development center, Space Services will launch a materials science experiment payload aboard their Starfire rocket from White Sands Missile Range, N.M., in March 1989.

The experiment package will include six primary microgravity investigations. About eight minutes of "weightlessness" will be achieved during the suborbital rocket flight.

The NASA grant, funding the purchase of commercial launch services to carry out the research flight, is representative of federal efforts to encourage and stimulate the growth of a U.S. commercial launch industry.

NASA support, along with financial contributions by industrial firms interested in the commercial potential of space, also funds the research and development activities of the CMDS.

The University of Alabama-Huntsville center, one of 16 NASA CCDS centers, is focusing on commercially-promising areas of research in the field of using the unique qualities of space for materials processing.

Space Services Inc. was awarded the launch services contract following a competition advertised and managed by CMDS. The flight will be the first commercial launch by the firm. ■

TDRS-3 Satellite Passes Early Tests With Flying Colors Says Goddard

The Tracking and Data Relay Satellite (TDRS), launched by the Space Shuttle Discovery on Sept. 29, has performed flawlessly on all tests so far, according to NASA officials at Goddard Space Flight Center, Greenbelt, Md.

TDRS provides comprehensive telecommunications services by relaying voice, television, digital and analog signals between low-Earth-orbiting spacecraft, including the Space Shuttle and the ground.

Since its launch by the crew of Discovery, the 5,000-pound communications satellite, known as TDRS-3, has been moved for testing to 150 degrees west longitude over the Equator. This location is best for communications with the White Sands Ground Terminal in New Mexico, for spacecraft antenna testing, for pre-mission tests and mission support for STS-27.

Following deployment of the satellite's antennas and solar arrays, the satellite's thrusters were first fired on Oct. 2 to start TDRS drifting towards the test location. The satellite's movement was stopped by additional firings on Oct. 11 and 12 when it arrived on station.

Spacecraft communication systems were activated between Oct. 7 and 18. All systems performed flawlessly and testing is ahead of schedule, according to Dr. Dale W. Harris, TDRS project manager at Goddard. Although tests and calibrations would not be complete, NASA hoped to use the TDRS-3, along with TDRS-1 launched in April 1983, for improved communications during the STS-27 mission.

TDRS-3 is the third to be launched. The first has been in operation since 1983 and is located at 41 degrees west longitude. The second was lost with the Challenger. The fourth, to complete NASA's constellation of three on-orbit satellites, is scheduled for launch on the Discovery in February 1989.

The TDRS satellites are built by TRW Space & Technology Group, Redondo Beach, Calif. The satellites are owned and operated by Contel Federal Systems of Fairfax, Va., which also operates the White Sands Ground Terminal under a lease agreement with NASA.

Orbiting at 22,250 miles above the Earth, the tracking and data relay satellites look down on NASA's fleet of low-Earth-orbiting spacecraft and shuttles, tracking them worldwide and relaying two-way communications between them and mission control centers through a single ground station at White Sands, N.M.

NASA established the Tracking and Data Relay Satellite System (TDRSS) to increase the flow of information between low-Earth-orbiting spacecraft and the ground.

With two operational TDRS, low-orbit spacecraft are in communication with Earth for about 85 percent of each orbit. Before the TDRS system, spacecraft could communicate with Earth only when they were in sight above one of several ground tracking stations, typically less than one-sixth of an orbit. ■

Surgeon General Addresses NASA Occupational Health Meeting

Dr. C. Everett Koop, Surgeon General of the United States, addressed NASA's Occupational Health program annual meeting held recently in San Antonio, Texas.

These meetings present speakers who are leading authorities on current occupational health issues, and provide opportunities for center occupational health personnel to review health matters of common interest.

Koop's keynote address emphasized the increasing responsibilities of federal agency medical programs in the delivery of preventive health care in addition to traditonal emergency care for accidents and illnesses. Koop also noted the value of data sets collected at Center health units which can be used to illustrate "life benefits" that accrue from prevention and health promotion efforts.

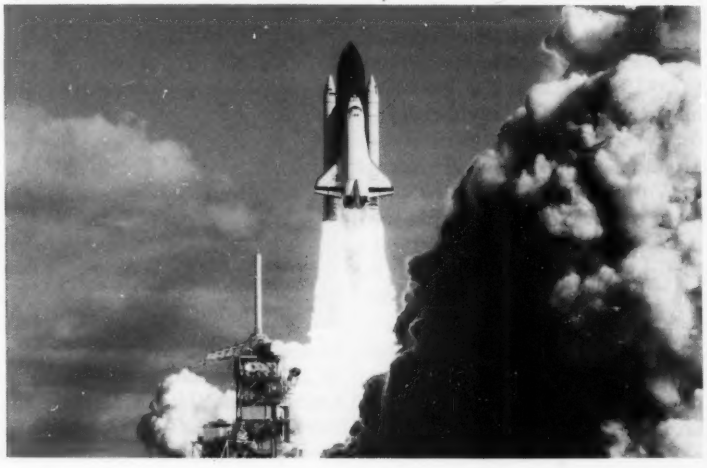
This year's meeting emphasized employee assistance programs and occupational health nursing.

Dr. C. Howard Robins, deputy associate administrator, NASA Office of Management, discussed the development of the Office of Management Strategic Plan. ■

(from left) Marshal S. Levine, M.D., MPH, director, NASA Occupational Health Division; Surgeon General Koop, and C. Howard Robins.

STS-27 Atlantis Flight, A Dedicated DoD Mission

The STS-27 Atlantis Space Shuttle roared to orbit at 9:30 a.m. EST, December 2, 1988, after a one-day weather postponement. The mission, a classified, Department of Defense dedicated Space Shuttle flight, was crewed by astronauts (from left) Guy S. Gardner, pilot; William M Shepherd, mission specialist; Robert L. Gibson, mission commander; Richard M. (Mike) Mullane, mission specialist; and Jerry L. Ross, mission specialist. STS-27 was the 3rd flight of the Space Shuttle Atlantis. It flew the STS-51J DoD mission in October 1985 and the STS-61B mission in November 1985 launching the Morelos B, Aussat 2 and Satcom KU-2 communications satellites. Atlantis was delivered to NASA in 1985 from the shuttle assembly facility in Palmdale, Calif., and is the lightest weight Space Shuttle. STS-27 is pictured below during launch from pad 39B, Kennedy Space Center, Florida.



NASA Presents 1987 Excellence Award to Rocketdyne

The Rocketdyne Division of Rockwell International Corp., Canoga Park, Calif., has been named recipient of the 1987 NASA Excellence Award for Quality and Productivity.

NASA Deputy Administrator Dale D. Myers, who announced the selection of Rocketdyne at the annual NASA Contractors Conference, said that for well over two years, Rocketdyne has applied the highest possible level of talent and resources to provide a safe return to flight for the Space Shuttle.

Rocketdyne, primarily responsible for design, development and production of the Space Shuttle main engines (SSME), was one of eight finalists in NASA's third annual awards program, which recognizes the agency's aerospace industry contractors, subcontractors and suppliers that consistently demonstrate ways to maintain and improve the quality of their products and services.

During the hiatus between Space Shuttle launches, Rocketdyne conducted an intensive reexamination and margin improvement plan for the SSME. The proof of their results were shown in tests on the main engines totaling more than 358,089 seconds—the equivalent of 229 Space Shuttle launches. These tests included the longest test firing in the history of rocket motors, a test firing of 2,017 seconds or almost four times the nominal duration of an actual flight firing.

Rocketdyne was selected to be the recipient of the Excellence Award by the NASA Productivity Steering Committee, based on review of the findings report and recommendations of the evaluation committee. ■

JPL Automated Infrared System to Map Forest Fires

An infrared remote sensing system employing specialized data-processing techniques is being developed at NASA's Jet Propulation Laboratory (JPL), Pasadena, Calif., to provide forest fire mapping for fire fighters. The work is being accomplished in conjunction with the Forest Service.

Called Firefly, the new project calls for a compact, computerized flight system mounted in a Forest Service aircraft. It will integrate multichannel infrared images from its sensor with location data from the aircraft's navigation system, producing simple, precise map information on the fire's perimeters and associated hot spots. This information will be transmitted in digital form to the Forest Service's portable field computer system. A special ground terminal will then construct fire maps for field commanders while the survey is still in progress.

JPL is responsible for developing the airborne part of the system, including software, while the Forest Service is developing the digital communications link and the ground terminal, both to be integrated into its field computer and communications system.

Firefly is the outgrowth of previous JPL work sponsored by the Forest Service and NASA's Office of Technology Utilization. The system draws on many years of NASA technical developments in remote sensing and JPL's 25-year development of digital image processing used for enhancing spacecraft pictures of other planets and for Earth applications ranging from medical diagnosis to geological exploration. The system also benefits from the growth of a commercial infrared-sensor industry, based on space and defense-related technologies.

The earlier, JPL-developed, Forest Service infrared survey technology is the Fire Logistics and Mapping Equipment (flame) infrared line scanner system used extensively on major fires, including the summer 1988 Yellowstone conflagration. The flame system captures its data on film, but requires the aircraft to land before an interpreter can perform a time intensive, hand transfer of data to working maps. Firefly, however, will use space-based Global Positioning System satellites for more accurate mapping and will transmit processed data directly to the fire incident camps for computer plotting on working maps, significantly reducing the time between observation and mapping.

"Cutting the turnaround time in getting information to the firefighters is the key," says Dr. J. David Nichols, JPL's task manager for Firefly. "We will gain time in two ways: processing the data and integrating the location information in the airborne computer and communicating directly, computer-to-computer, with the mapping system on the ground."

Another strength of the system is its modular design, which eases maintenance and facilitates the use of cost-reducing off-the-shelf hardware and later system upgrades. Subsequent modifications to the remote-sensing system could increase the number of channels allowing surveys of pest damage, disease and other adverse effects before each fire season.

The developers hope to test Firefly software and data-handling equipment with outputs from the flame sensor by the 1991 fire season and to have the full Firefly system operational during the 1992 season.

The task is managed by the JPL Environmental Technology Program Office, headed by Dr. Amy L. Walton. William L. McCleese is Firefly's project manager at the U.S. Department of Agriculture's Forest Service, Washington, D.C. ■

Firefly will provide forest fire mapping information from aircraft directly to portable field computer ground terminal locations for constructing fire maps.

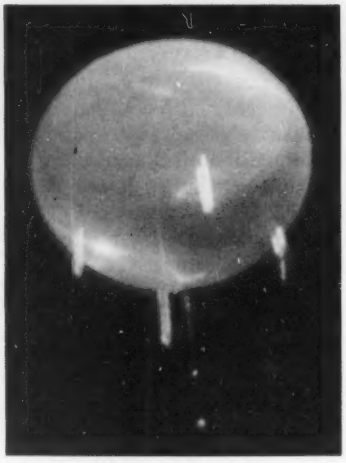
Supernova Balloon Studies Continue From Australia

Two NASA heavy-lift balloons have been launched from Australia to continue scientific studies of Supernova 1987A, marking the fifth Supernova campaign conducted in the past two years.

A 28.4 million cubic foot balloon carried a scientific experiment, weighing 1,100 pounds, to measure gamma-ray and hard X-ray emissions. Principal investigator is Dr. Gerald Fishman of NASA's Marshall Space Flight Center, Huntsville, Ala. A 29.47 million cubic foot balloon also carried a scientific experiment, weighing 3,700 pounds, that measured gamma-ray emissions, but over a different energy band. Principal investigator is Dr. Bonnard Teegarden, NASA's Goddard Space Flight Center, Greenbelt, Md.

A 1.05 million cubic foot balloon was also launched in this campaign, but is not related to Supernova 1987A studies. It carried an experiment designed to map radiation from the galaxy and cosmic microwave background with a low-noise maser radiometer. Results will be used in analysis of data from the Cosmic Background Explorer satellite scheduled for launch in 1989. Principal investigator is Dr. Ed Chang, Massachusetts Institute of Technology, Cambridge, Mass. NASA has completed 17 Supernova 1987A scientific balloon flights from Australia since the exploding star was first discovered in February 1987. These investigations were conducted in four campaigns from Alice Springs in the Northern Territory and were part of a three-tiered effort by NASA to study the Supernova.

Other efforts included six sounding rockets launched in two campaigns from the Woomera Range in South Australia and a NASA aircraft research effort from New Zealand. The flights were carried out from Australia and New Zealand because the supernova is only visible in the Southern Hemisphere. The balloons carried scientific experiments to detect gamma ray emissions and the sounding rockets carried X-ray and ultraviolet experiments. All payloads were recovered successfully, refurbished and are ready for other flights.



A 23.3 million cubic foot balloon at float over Alice Springs, Australia, in an earlier study last spring.

These scientific missions are part of the overall NASA Balloon Program managed by the Wallops Flight Facility, Wallops Island, Va. The program consists of approximately 40-45 balloon flights a year launched from various worldwide locations including the NASA-managed National Scientific Balloon Facility in Palestine, Texas. ■

Fastest Supercomputer Installed at Ames Research Center

A Cray Y-MP, the fastest supercomputer in the world, is currently undergoing acceptance tests in the Numerical Aerodynamic Simulation Facility (NAS) at NASA's Ames Research Center. Ames is the first organization to have the new supercomputer which is expected to be fully operational by January 1989.

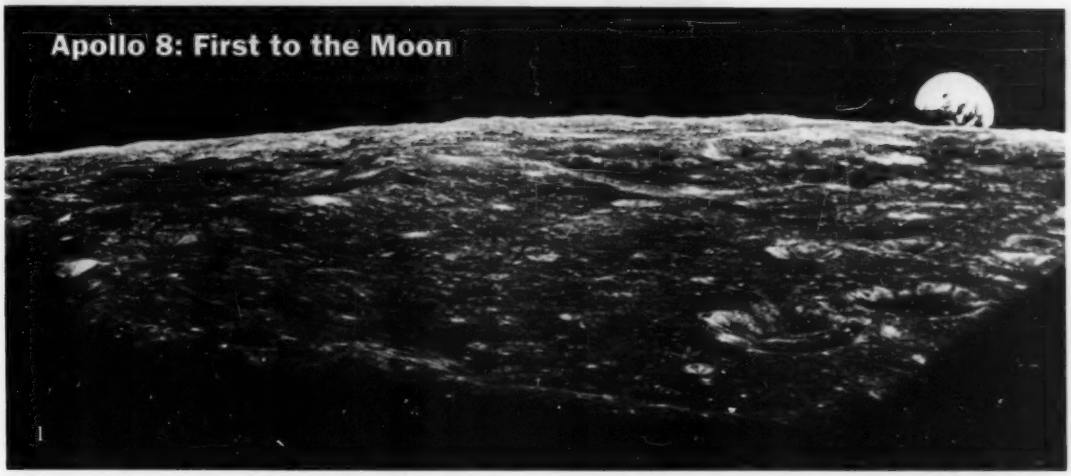
The Cray Y-MP can exceed one billion computations per second in sustained operation and has achieved peak speeds of 2.37 billion computations per second by concentrating all of its eight processors on a single scientific simulation. The sustained speed of one billion calculations per second is the highest for any existing computer in the world.

Supercomputers like Cray's new Y-MP provide a way of replicating aircraft and spacecraft flight by virtually "flying" the craft inside the computer. To do this, the airflow is computed on a three dimensional grid surrounding the vehicle which consists of as many as a million separate points. The number of computations required for flow simulation on this grid can reach one trillion.

NAS officials seek computation speeds of one trillion (1,000 billion) calculations per second before the turn of the century. Such a speed would revolutionize aerospace science by allowing researchers to reproduce a series of optimum designs for a given flight problem, calculating all the variables and doing it quickly. ■

NASA VISION

Apollo 8: First to the Moon

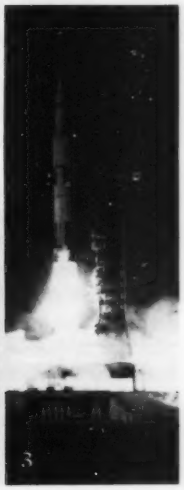


It was Christmas time, 1968, that man broke his bonds to Earth. Three Americans, Frank Borman, James A. Lovell Jr., and William A. Anders, guided their Apollo 8 spacecraft across nearly a quarter-million miles of black void, out of the grasp of Earth, into orbit around the Moon, and back once more to a chosen pinpoint on their home planet.

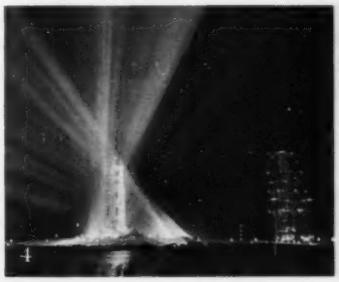
On reaching the vicinity of the moon, they braked their spacecraft into 69 mile high lunar orbit and circled the moon 10 times. Then they fired the service engine again to boost the spacecraft out of lunar orbit and into the narrow return corridor to Earth. It re-entered earth's atmosphere at an altitude of 400,000 feet, travelling at more than 24,000 miles per hour, and landed safely in the Pacific Ocean 147 hours and 11 seconds after lifting off the launch pad of Complex 39 at Cape Kennedy.

Never before had man traveled so far, so fast or looked so closely upon another celestial body. Never before had so many millions listened and watched, their imaginations stretched, as the explorers spoke across the emptiness. Never, indeed, had adventure ever borne all mankind so daringly near the boundaries of its aspirations.

On Christmas Eve, as the eyes of the world followed Apollo 8 across the moonscape, the astronauts invoked another, older voice, reading in turn the first 10 verses of Genesis, the story of Creation. Its conclusion—"... and God saw that it was good"—echoed in Astronaut Borman's words as again Apollo 8 headed into the silent, tantalizing absence of earthly communications: "God bless all of you—all of you on the good Earth." ■



1. Earthrise after lunar orbit insertion. 2. Apollo 8 crew after first trip to Moon. 3. Saturn V boosts Apollo 8 toward lunar destiny with 7.5 million pounds thrust. 4. Launch pad 39A, Kennedy Space Center with Saturn V Apollo.



Q&A

The following questions and answers are excerpted from interviews conducted for NASA's radio program, "The Space Story."

The Soviet Mir Space Station and NASA

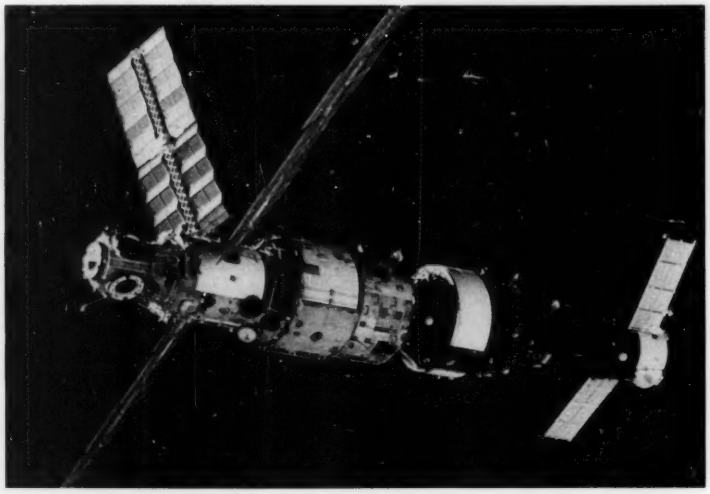
The Space Shuttle is back flying and progress is continuing on Space Station Freedom. Because of this, we hope to join the Soviet Union in long duration space living. The Russians, with their latest space station Mir, have amassed almost 6,000 man/days in space. The Mir's two cosmonauts will have spent one full year in space upon their return to earth December 21, 1988.

Q Can the American manned space program gain anything from the Soviet's experience in space?

A Dr. B.J. Bluth, of NASA's Space Station Program Office, is concerned that we obtain and use such information. She says, "we're interested in what the Russians are doing because they have had the only experience on the planet in really long duration space flight. They've been there and they know what it's like and we're planning to build a space station and we want our crews to stay a long time.

So rather than spend years and years learning from our experience, what we can do is learn from what they have done so that when we come down to design our equipment, design our space station, plan our operations, we can learn from that experience and we don't have to make the same mistake twice....

It's much better to talk to the guy who's been there and find out what he learned from his adventure...."



Soviet Space Station Mir.

Q How do we go about obtaining this information?

A "The way we get information is multiple. We get translations of the news reports that come out of the Soviet Union all the time. I go to conferences, I talk to cosmonauts, I talk to engineers, I talk to scientists, I talk to physicians. You talk to all those people and most technical people pretty much are open. They share the information, you know, they tell you what's going on. And lately it's been far more open. There's a lot more information than there was before and they usually tell you the truth."

Q What have they found out about humans exposed to long periods in space?

A "What they found out is that there is a very big difference between a long duration flight and a short duration flight. There's a qualitative difference. It's the difference between a date and getting married. You go out with somebody for a week or so and you have a good time and that's really nice. But being married to somebody for your life, is a much different thing. So they found out that long duration flight requires a lot of concern about the habitability, the design of the equipment and the design of the operation so that you don't over stress and over fatigue the crew.

What they say is, that the crew is the point of consciousness between their entire space program on the ground and all those people who want to participate in collecting and analyzing all that data and the equipment and the space environment. So for them, the crew has to be alert, motivated, quick, agile. They have to know what they're doing. So... they see the crew as the absolutely critical crux of the entire program.... And they've also found out that having crews up for a long time is much better than having crews up for a short time because they adapt. It takes a while to adapt to weightlessness." ■

NASA NEWS CAPSULES

News Capsules are NASA news releases edited by the Internal Communications Branch, Office of Communications.

General Electric to Furnish Satellite Tracking Ground Terminal

NASA has selected General Electric Co., Valley Forge, Pa., for final negotiations leading to award of a contract for the phase II implementation of the second Tracking and Data Relay Satellite System (TDRSS) Ground Terminal (STGT).

The contract will require the contractor to develop, fabricate, install and test the communications hardware and software to implement the STGT. Final installation and acceptance will be at the STGT site on the White Sands Test Facility, N.M.

General Electric's proposed cost for the basic STGT effort is approximately $202 million. The contract also will contain a separately priced option for upgrading the existing TDRSS White Sands Ground Terminal (WSGT). The cost proposed by General Electric for the WSGT option is approximately $60 million.

The STGT will be located at this site, under construction, at NASA's White Sands Test Facility, New Mexico.

The principal location for the design, development, fabrication and development testing will be General Electric's Military and Data Systems Operations facilities in Valley Forge, with participation by subcontractors in New York and California.

The contractor will provide for a fully operational ground terminal compatible with NASA's space network. In conjunction with the Tracking and Data Relay Satellites, the STGT will provide communication and tracking services for space-network user satellites. It also will perform tracking, telemetry and command services for the Tracking and Data Relay Satellites themselves.

The Mission Operations and Data Systems Directorate, Goddard Space Flight Center, Greenbelt, Md., will manage the contract. The STGT is under the overall direction of the Office of Space Operations, NASA Headquarters, Washington, D.C.

Goddard Seeks Proposals for Telerobotic Servicer

NASA's Goddard Space Flight Center has issued a request for proposal which will lead to the award of a prime contract for the design, development, testing and fabrication of Space Station Freedom's flight telerobotic servicer (FTS).

The FTS will be a space robot with automated features that will assist crews in the assembly, maintenance and servicing of the Freedom station and visiting spacecraft.

The FTS program consists of a developmental flight test on the Space Shuttle in 1991, followed by a demonstration test flight of the prototype robot on the Space Shuttle in 1993. The FTS is scheduled to be launched on the second Freedom station assembly flight.

Initially, the FTS will be capable of performing such diverse tasks as installing and removing station truss members, installing fixtures on the truss, changing out station orbital replacement units, mating thermal utility connectors and performing inspection tasks.

The FTS will enhance crew safety and productivity. Crew members aboard Freedom will use the FTS to perform potentially hazardous tasks and to relieve astronauts on extravehicular activities from routine tasks.

Lewis Research Center and Argonne National Lab Sign Superconductivity Agreement

NASA's Lewis Research Center and the Argonne National Laboratory, have signed an agreement to begin joint research in the development of high temperature superconductivity (HTS) materials and technology. The program is regarded by both parties as having the potential to provide significant economic benefits and a world leadership role for the United States.

The objective of this major research effort is to exploit recent rapid advances in HTS technology for significant space and aeronautical applications. Research and technology development will be undertaken in those areas where HTS could be an enabling technology or substantially improve existing systems.

Initially, research will concentrate on advanced studies and critical exploratory experiments to identify the most promising applications for further development. Among the first candidate applications will be superconducting magnetic energy storage, space electromagnetic propulsion, microwave power transmission, aeropropulsion applications and electromagnetic launch systems.

NASA Selects Small Business Research Proposals

NASA has announced the selection of 202 research proposals for immediate negotiation of phase I contracts in NASA's 1988 Small Business Innovation Research Program (SBIR). Proposals were selected from 166 small, high technology firms located in 28 states. It is anticipated that more than 20 additional phase I awards will be chosen at a later date.

SBIR objectives are to stimulate technological innovation in the U.S., use small business (including minority and disadvantaged firms) to help meet Federal research and development needs and to encourage commercial applications of Federally supported research innovations.

Phase I projects are six-month, fixed price contract efforts, normally not exceeding $50,000, to establish the feasibility of innovative research concepts proposed by the contractor to meet agency needs or opportunities described in the SBIR program solicitation.

Administrator Awarded Rockwell Medal, Elected to Hall of Fame

Dr. James C. Fletcher, administrator of NASA, received the International Technology Institute's (ITI) highest award, the Willard F. Rockwell, Jr. Medal, recently at the International Congress on Technology and Technology Exchange banquet in Pittsburgh. In addition to the award, Dr. Fletcher was elected to the World Level Hall of Fame for Engineering, Science and Technology.

Established in 1982, the Willard F. Rockwell, Jr. Medal is awarded to recognize contributions toward the generation, transfer and application of technology for the betterment of mankind. According to ITI, "recipients are persons of high stature in the international technology community."

Dr. Fletcher, who has worked on the frontiers of technology as a scientist most of his professional life, said during his acceptance speech that, "Technology will help to lay the groundwork so that future generations will harness riches from space for all mankind. I'm a strong believer in technology and all its promise as a tool for the betterment of humanity." Dr. Fletcher also cited NASA's most recent Space Shuttle Discovery mission as an "engineering marvel."

Each year the medal is awarded to a maximum of three individuals, no more than one from any continent, for excellence in technology. This year's recipients were Dr. Fletcher and Dr. Chauncey Starr, founder of the Electric Power Research Institute. Previous recipients include Dr. Luis Alvarez, professor emeritus, University of California; Dr. Genichi Taguchi, executive director, American Supplier Institute; Dr. Janos Prohaszka, director, Institute of Mechanical, Technical and Materials Science, Hungary; Dr. Robert C. Seamans, Jr., chairman, Aerospace Corp.; Dr. Hans List, founder, List Institute of Technology, Austria; and Dr. Allen E. Puckett, chairman and CEO, Hughes Aircraft Co.

The medal is named in honor of its first recipient, Willard F. Rockwell, Jr., chairman of the board and CEO of Astrotech International Corp. Rockwell is former chairman of the board of Rockwell International. ■

HUMAN FACTORS

Martin Named Assistant Administrator for Exploration Office

NASA Administrator James C. Fletcher has named Dr. Franklin D. Martin assistant administrator for the Office of Exploration. John Aaron, who has been acting in that capacity since the office was created in August 1987, is returning to the Johnson Space Center, Houston, as a special assistant to the center director.

The Office of Exploration is responsible for coordinating agency planning activities that expand exploration and the human presence beyond Earth, particularly to the Moon and Mars. Primary concentrations of the Office of Exploration include mission concepts and scenarios, science opportunities, prerequisite technologies and research, precursor missions, infrastructure support requirements, as well as exploration programmatic requirements of resources and schedules.

Martin served as the deputy associate administrator for the Space Station office, a position he held since September 1986. The Office of Space Station is responsible for the activities required to develop the permanently manned Freedom space station, planned for deployment in the mid 1990's.

From 1983 through 1986, Martin was at NASA's Goddard Space Flight Center, Greenbelt, Md., as director of sciences and of space and earth sciences. Goddard carries out broad programs of theoretical and experimental scientific research. From 1974 through 1983, Martin served in a variety of positions at NASA Headquarters.

Prior to joining NASA, he served as a physicist with the Naval Oceanographic Office and as an aerospace engineer for Lockheed in Houston, where he was involved in the science mission support of Apollo's 16 through 17.

A native of China Grove, N.C., Martin attended the University of Tennessee where he received his Ph.D. in physics in 1971. He received an A.B. with majors in physics and math from Pfieffer College, Misenheimer, N.C., in 1966.

Wintucky Outstanding Disability Employee

NASA's Outstanding Federal Employee with a Disability for 1988, is William (Bill) T. Wintucky, deputy manager, propulsion systems project office at Lewis Research Center, Cleveland.

He was honored October 19th, at a special luncheon hosted by the Office of Equal Opportunity Programs and the Personnel and General Management Office.

In August, Wintucky was also selected as one of twelve winners of the 1988 Presidential Award for Outstanding Federal Employees with Disabilities.

Wintucky directs a wide range of contracted research for the Department of Energy and the Department of Defense to advance the technologies of diesel engines.

In 23 years as a successful supervisor, Wintucky has been head of a number of research groups and has been very influential in the design and development of several power systems for use in space.

For the past four years he has served as project manager of a joint U.S. Army/NASA technology program for an ultra-high performance, light-weight compound cycle (turbine/diesel) engine, having a broad military application potential.

He was cited for "exemplary and outstanding accomplishments in the performance of his job and for his many contributions to the agency and the community."

William T. (Bill) Wintucky (seated) has been named NASA's 1988 Outstanding Federal Employee with a Disability. Presenting honors were (from right) Dr. James C. Fletcher, administrator; Dale D. Myers, deputy administrator; Lynda Sampson, handicapped program manager; Dr. Robert Rosen, deputy associate administrator, OAST; and Stanley S. Kask, Jr., deputy for personnel.

Cantus Resigns From NASA

H. Hollister Cantus, associate administrator for external relations, has resigned from NASA to return to private industry. Cantus has accepted a position as vice-president for government requirements with Lockheed's Missile and Space Systems Group, Washington, D.C.

Cantus became associate administrator in February 1987 after retiring as group vice-president from United Technologies Corp. His previous government positions included deputy assistant secretary of defense, director of congressional relations for the Energy Research and Development Administration, and professional staff member of the House Armed Services Committee. Cantus also served 10 years on active duty as a naval flight officer and retired from the Naval Reserve as a captain in 1984.

Cantus came to NASA after the Challenger tragedy. In response to the recommendations of the Phillips' Committee, NASA consolidated functions relating with Congress; other agencies of the federal government; foreign, state and local governments; industry and the educational community into the Office of External Relations. Cantus was the first incumbent of this consolidated activity.

In accepting his resignation, NASA Administrator Dr. James C. Fletcher said, "As you leave, you can be satisfied that a good measure of our progress can be attributed to your good work."

Stovall Appointed Deputy Director, Headquarters EEO

Sheree D. Stovall was named Deputy Director, Headquarters Equal Opportunity Office/Manager, Headquarters Hispanic Employment Program.

Stovall recently completed a three-year assignment with the Office of Equal Opportunity Programs.

Prior to her initial NASA assignment, she held positions in the Department of the Army, Rock Island Arsenal, as an Equal Opportunity and Personnel Staffing Specialist.

From 1980-1981 she was a consultant with McClure Lungberg and Associates and worked with a number of Federal agencies including the United States Civil Rights Commission, Department of Transportation and Department of Commerce.

Christensen appointed Deputy Assistant Administrator, Headquarters Operations

Michael D. Christensen has been appointed the Deputy Assistant Administrator for Headquarters Operations and will be the principal assistant to the Assistant Administrator for Headquarters Operations.

Christensen comes to NASA from the Agricultural Research Services (ARS) where he served as Associate Deputy Administrator for Management. In this position he participated fully in management of the following functional areas: Personnel, Financial Management, APD Services, Real and Personal Property, Health and Safety Procurement, and Construction and Facility Engineering.

Christensen was previously employed by NASA between 1967 and 1979. He joined the agency as a Federal Personnel Intern at Headquarters and later was assigned to the Kennedy Space Center and the Johnson Space Center. In 1975 he was selected as the Deputy Chief of the Manpower Utilization Division at the Goddard Space Flight Center. Between 1978 and 1979 he also served in a dual capacity as staff assistant to the Director of Administration.

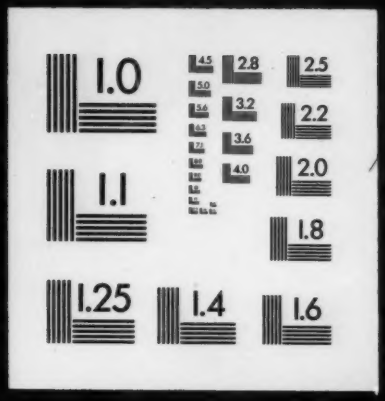
Zukor, Robertson, Keegan Named Assistant Executive Officers

Three new assistant executive officers have been selected for two-year tours as key staff assistants to NASA's top management. Dr. Dorothy J. Zukor has been selected assistant executive officer to the administrator, Nancy G. Robertson, Assistant Executive Officer to the Deputy Administrator, and Richard Keegan, Assistant Executive Officer to the Associate Deputy Administration for Institution.

Zukor has served as a project safety manager, Office of Flight Assurance, at Goddard. Before coming to Goddard, she served with the Nuclear Regulatory Commission in the field of reactor safety.

Robertson worked at the Johnson Space Center as a program financial analyst for such projects and activities as the Large Area Crop Inventory Experiment, Orbit Development and Production, and Space Station. She also managed the JSC University Programs activities.

Keegan has been a procurement manager at Goddard, most recently for the Tracking and Data Relay Satellite System. Previously, he worked as contract specialist at Goddard and the Department of Energy. ■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